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(54) Title: GELLED FOOD PRODUCTS CONTAINING MICROPARTICULATE SUSPENSIONS

(57) Abstract

A gelled food product containing a microparticulate suspension of an edible food ingredient, such as fats/oils, entrapped in a heat-set protein gel, such as egg white, blood serum or whey, is prepared.

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GELLED FOOD PRODUCTS CONTAINING MICROPARTICULATE SUSPENSIONS

This invention relates to the preparation of microparticulate suspensions stabilised in heat-set gels for food applications.

Thermally induced gelation occurs when restricted protein unfolding yields soluble polypeptide segments capable of specific interactions which form a well ordered three-dimensional network able to entrap large amounts of water. The ability of unfolded proteins to associate and form a gel depends upon the protein, its amino acid composition and molecular weight, the protein concentration, heating temperatures and rates and a critical balance between attractive and repulsive forces.

Cross-linking is essential for gel formation; hydrogen bonding, ionic and hydrophobic interactions and covalent disulphide bonding are critical intermolecular interactions for gel formation. The difference observed between globular proteins in their ability to form gels reflects different types of protein-protein interactions and the number and extent of interactive sites in the protein aggregates.

Milk proteins undergo gelation after several types of treatment but only those known as the whey proteins are capable of heat-induced gelation. Beta-lactoglobulin is considered to be the most important whey protein for gelation since it is capable of forming uniform gels of high breaking strength due largely to its ready ability to enter into disulphide-mediated cross-linking upon heating.

Egg white proteins are widely used in food preparations requiring high gel strength and heat-set properties, although the bonding is exclusively non-covalent. Special conditions in terms of electrostatic repulsion between the protein molecules are required for gelation and may be achieved by manipulating the pH, type of salt and salt concentration.

Blood plasma proteins are often incorporated into manufactured meat products to effect improvement in water holding capacity through formation of a gelled structure.

The use of gellable proteins in food systems has been described widely as thickening, binding and water binding agents.

US Patent No. 3,892,873 described the replacement of egg yolk in salad dressings and mayonnaises by partly thermally denatured whey proteins acting as thickener.

Emulsions of greater firmness were achieved by the process described in Australian Patent No. 578,879, which involved emulsifying a lipidic substance with gellable whey protein, such as whey protein concentrate, and heating strongly. For a given protein concentration, the viscosity of the emulsions obtained after emulsification increased considerably with the lipid concentration. The protein-to-lipid ratio was selected according to the nature, firmness of texture and nutritional properties required in the products. The firmness of products was also influenced by the heating temperature. For a cream type product, heating at a temperature of the order of 90 °C at atmospheric pressure for a treatment time of about 15 minutes was required. To obtain a gel like an egg-custard, it was preferred to place the emulsion into containers which were hermetically sealed, the heat treatment being then applied in an autoclave at 115 °C for 15 to 30 minutes. The texture of the product was also determined by the diameter distribution of the oil globules; only if it was narrow reflecting intensive homogenisation, was a firm gel obtainable. Compressive forces causing a rupture of the gel were in the ranges 0.2 - 1.0 (very soft), 1.0 - 2.0 (firm) and 2.0 - 4.0 (very firm) N/cm^3.

We have now found that by selection of appropriate heat-gelling protein and with appropriate selection and treatment of certain microparticulate food ingredients, gelled products may be obtained in which contain the

microparticulate ingredients in suspension and which are of much greater firmness than the products obtained by the process of Australian Patent No. 578,879.

The microparticulate suspension may consist in whole or part of an emulsion of a fat or oil.

The gel strength of the gelled food products described by this invention may be modulated by the concentration of the protein and other factors.

However, while the products arising from the process described in Australian Patent No. 578,879 show viscosities which increase with lipid or other included microparticulate substance up to a level dependent on the nature of the substance.

The difference between the two processes is further illustrated by the fact that to obtain even a soft, egg custard-like gel by the process of Australian Patent No. 578,879, required heating emulsions in hermetically sealed containers in an autoclave at 115 °C whereas much lower temperatures can be used in the practice of this invention.

Using the process of this invention a wide range of new products including "low-fat" products with attractive texture may be prepared utilising various combinations of heat-gellable proteins, at varying concentrations, and a variety of microparticulate components. Further variation may be obtained in the food product by addition of soluble substances including salts, colorants, flavourants and sweeteners in the protein solution prior to gelation.

In our International patent application No. PCT/AU88/00141, "Whey Protein Fractions" we describe a product, the "beta-fraction", which by virtue of its beta-lactoglobulin content, demonstrates greater gel strength properties and versatility than other whey protein or other food protein products.

We have now discovered in particular that we can disperse fats/oils, in an emulsified state, in beta-fraction solution and subsequently "fix" (entrap) the fat droplets (microparticles) by heating and gelling the beta-fraction protein around them. At a level of fat/oil around 5-10% w/w in the gel the product has "fat-like" qualities (mouthfeel, opacity, juiciness etc), in other words it behaves like a "low-fat" fat. Surprisingly in (or below) this fat content range the dispersed fat has little effect on the strength of the gel, and thus rheological characteristics can be largely determined by the protein content and solvent composition. The gel holds a large quantity of water tightly and if the fat is well homogenised there is no free fat leakage. The product can be sliced, diced, chopped or minced and because the gel is formed by heating at around 90 °C this "low-fat" fat can be used as fat replacement in comminuted products that are to be heated.

According to one aspect of the present invention, there is provided a gelled food product comprising a microparticulate suspension of an edible food ingredient in a heat-set gel.

In another aspect the invention provides a gelled food product comprising an enriched beta-lactoglobulin, more preferably the beta fraction.

According to a further aspect of the present invention, a process for the preparation of a microparticulate suspensions entrapped in heat-set gel comprises the steps of:

(a) preparing an aqueous microparticulate suspension or dispersion of at least one edible food ingredient which is insoluble in water or aqueous solutions;

(b) mixing the microparticulate suspension or dispersion from (a) with a protein capable of forming a uniform gel when heated, the proportions of said suspension or dispersion and the protein being suitable to form

the desired product;

(c) heat treating the mixture from (b) to form a heat-set gel containing said suspension or dispersion;

(d) cooling the heat-gelled mixture from (c) to ambient or sub-ambient temperature.

The preferred parameters for the steps of the process of the invention will now be discussed in more detail.

The microparticulate suspension or dispersion of edible food ingredients in the aqueous medium may be prepared by any suitable process, e.g. by homogenisation so that the particle size is reduced to an effective diameter within the range 100 to 100,000 nanometers. The size of the dispersed particle may be optimised in relation to their buoyancy in, and interaction with the gellable protein solution when the two are mixed.

Step (b) involves selection of a thermally gellable protein which should dissolve or disperse in an aqueous medium at a concentration in the range of 10 to 150 g/L of true protein. To be considered suitable for use in the present process a protein should have a gel breaking strength at least equal to that of gelled egg white with an equivalent protein concentration when heated at 90 °C for 30 minutes. The protein may be in its natural state or isolated by any suitable method which enables its heat gelation properties to be retained. For example, suitable proteins may be sourced from egg white, blood serum or whey, or mixtures thereof. Enriched beta-lactoglobulin in the form of beta-fraction prepared according to Pearce (1988), is the most preferred protein.

[Note: References are listed at the end of this description.)

The protein may be added to the microparticulate suspension or

dispersion in the solid or liquid state. The proteins may be dissolved or dispersed in water or any other suitable aqueous or non-aqueous liquid before mixing with the microparticulate suspension or dispersion. The gel strength may be modified by adjustment of the concentration of protein.

Also in step (b) other components soluble in an aqueous medium may be added to provide modulation of the strength of the gelled product after heating or sensory qualities including saltiness, sweetness, colour and flavour. In the instance of enriched beta-lactoglobulin as gellable protein the strength of the heat-set gel has been shown to be dependent on the pH, the sodium ion content and the calcium ion content (Mulvihill and Kinsella, 1987). Other ions may also be influential, for example potassium and magnesium ions. Such additional components may be added as such at step (b) or dissolved or dispersed with the protein before addition.

In the mixing operation, the usual approach is to mix a proportion of the microparticulate suspension from (a) with the protein (in solid form or as a solution or dispersion) so as to provide a maximum volume of suspended microparticulates of about 30% by volume and to achieve a gellable protein concentration in the range 10 to 150 g/L of true protein. Preferably the volume of suspended microparticulate is less than 15% and the protein content corresponds to between 50 and 110 g/L of true protein. Generally incorporation of air should be avoided, unless air bubbles are a specific requirement in the final product.

In step (c), the mixture from step (b) is heat treated, preferably at a temperature in the range 25 to 100 °C for from 5 to 120 minutes, more preferably in the range 60 to 90 °C for from 15 to 60 minutes. After the heat treatment the mixture is cooled to ambient temperature or below (step (d)). One suitable heat treatment method is to place the solution in a vessel which is preferably closed but not hermetically sealed, and which, if required, may be in the form of a moulding device. Heat treatment may also be carried out by

any other suitable method.

When the gellable protein is natural egg white, the gelled product after heating without the microparticulate suspension, is white and opaque; consequently the product containing suspended microparticles will also be opaque. However, conditions of pH and ionic content have been described which allow the major protein of egg white ovalbumin, to be heat-set as either transparent or opaque gels (Hegg et al 1979).

The form of heat-induced protein gels from blood plasma proteins may vary according to the level of protein fractionation of the product. While gelled whole plasma protein is opaque, conditions have been described in which blood serum albumin gels may be transparent (Yasuda, *et.al.* 1986). A comparison of the properties of heat-induced gels from egg albumin and bovine plasma proteins showed that plasma proteins produced a gel which was strong and elastic whereas egg albumin protein gels were fragile and brittle (Hickson, et al, 1982).

When the gellable protein is an enriched beta-lactoglobulin whey protein fraction, the gelled product after heating in the absence of a microparticulate suspension may be clear or opaque dependent upon the concentration of metal ions such as sodium and calcium ions (Mulvihill & Kinsella, 1987; Pearce, 1991). Consequently conditions of ionic content in the protein solution produced in the second step of the process may be selected so that the microparticulate suspension may be stabilised in a clear or opaque medium. The size and content of microparticulate component may also affect the appearance of the gelled product as, for example, when fat or oil is finely dispersed in the gel the product is white and opaque.

The nature of the selected microparticulate component may demand specific pretreatment in the preparation of the dispersion (step (a)) prior to mixing with the gellable protein solution. For example, in the dispersion of

fats or oils into a microparticulate state, homogenisation in the presence of an emulsifying agent may be necessary. The emulsifier may be the same protein as the gellable protein, if the latter displays good emulsifying properties in addition to high performance gelation. Alternatively the emulsifier may be another protein, provided that it does not interact adversely with the gellable protein and reduce its gelling performance, or it may be a naturally-occuring emulsifying substance, a chemical emulsifier, or a combination of these, provided that it does not interact detrimentally with the gellable protein.

Where additional soluble components are dissolved in the gellable protein solution their nature and content should be such that the gelling performance of the gellable protein remains satisfactory with regard to product requirements. The breaking strength of heat-set protein gels is influenced by pH and therefore, addition of acid or alkali (usually food grade) may be necessary to obtain the desired gelation performance.

To provide the desired organoleptic properties in the product, salt and/or suitable sweeteners, flavourants and colorants may be added together with the gellable protein in step (b).

Alternatively or additionally, in a product in which the microparticulate suspension is an emulsified lipid, the sensory properties of the gelled food product of the invention may be modified, for example to simulate the sensory qualities of fat. For example, the content and composition of emulsified fat or oil in the microparticulate suspension may be varied to allow selection of the nature of the gelled food product when used in a fat replacer. In addition lipid-soluble flavourants and/or colorants may be included in the suspension in step (a). The physical properties of gel strength, texture and opacity of the gelled food product may also be varied by adjustment of the protein and mineral contents.

When required, microbubbles of gas may be included or generated in

the gellable mixture so that when stabilised by heat-setting, the gel may have an aerated, spongy texture.

The invention is further described and illustrated by the following non-limiting examples. These examples demonstrate, *inter alia* the following features of the products of the invention.

1. The firmness of the product is determined by the concentration of gellable protein.

2. The firmness of the product is independent of the concentration of dispersed microparticulates.

3. When an oil is the dispersed microparticulate, the firmness of the product is independent of the source and physical characteristics of the oil.

4. The clarity of gelled product prepared from β-fraction as the gellable protein is modulated by mineral content.

EXAMPLE 1.

This example shows that the firmness of the product is determined by the concentration of gellable protein.

a) In the absence of suspended microparticulates

Aqueous solutions of β-fraction, a product derived from cheese whey (obtained by a thermal fractionation process and containing 75% protein on a dry matter basis and 65% of the protein being β-lactoglobulin) were prepared at pH 6.8 at different protein concentrations in the range 5.5 to 9.0% w/w. Aliquots (50mL) of β-fraction solutions were placed and sealed in dialysis tubing bags having a diameter of 30mm. Each bag containing protein solution was heated at 90°C for 30 minutes and cooled in running tap-water for 1 hour. Slices 30mm in length were cut from the gelled protein solution and evaluated for gel breaking strength using an Instron Universal Testing Machine in compressive mode at 20°C with a cross-head velocity of 50mm/min and fitted with a 10mm diameter circular disc probe applied to the centre of the cut surface. The results are shown in Table 1. Values reported are the mean of three determinations.

TABLE 1:

Protein Concentration	Gel Breaking Strength
(% w/w)	(g)
5.5	0
6.0	0
6.5	0
7.0	112
7.5	218
8.0	424
8.5	632
9.0	776

b) In the presence of suspended microparticulates

A microparticulate dispersion of butter oil in water was prepared by two stage homogenisation at 17.2 and 3.5 MPa at 50 °C, using β-fraction to stabilise the emulsion at an oil:protein ration of 10:1. The dispersion was mixed with solutions of β-fraction (as in Example 1 (a)) to yield a final concentration in the range 7.0 to 11.0% w/w of protein and a final oil content of 5% w/w. Aliquots of each mixture were heated to stabilise the microparticulate dispersion in a gelled protein matrix under conditions as used in Example 1 (a). Gel breaking strength was measured as in Example 1 (a). Results are shown in Table 2.

TABLE 2:

Protein Concentration in Mixture Containing 5% Oil Dispersion (% w/w)	Gel Breaking Strength (g)
7.0	160
9.4	570
11.0	845

EXAMPLE 2.

This example shows that the firmness of the product in general is independent of the concentration of dispersed microparticulates but this may not apply at high levels of microparticulates.

a) Butter oil dispersion

A microparticulate dispersion of butter oil was prepared as in Example 1 (b). Aliquots of the dispersion were mixed with β-fraction solution so that the final protein concentration was 9.4% w/w and the final oil concentration in the range 1.0 to 9.0% w/w. Portions of each mixture were heated to stabilise

the microparticulate dispersion in a gelled protein matrix under conditions as used in Example 1 (a). Gel breaking strength was measured as in Example 1 (a). Results are shown in Table 3.

TABLE 3:

Final Concentration of Oil Dispersed in β-fraction Solution at 9.4% w/w Protein (% w/w)	Gel Breaking Strength (g)
1.0	435
2.0	450
3.0	435
4.0	425
6.0	505
9.0	460

b) Cocoa powder dispersion

A microparticulate dispersion of cocoa powder was prepared by vigorous stirring of the powder in water. Aliquots of the dispersion were mixed with β-fraction solution so that the final protein concentration was 9.4% w/w and the final cocoa powder concentration in the range 1 to 5% w/w. Portions of each mixture were heated to stabilise the microparticulate dispersion in a gelled protein matrix under conditions as used in Example 1 (a). Gel breaking strength was measured as in Example 1 (a). Results are shown in Table 4.

TABLE 4:

Final Concentration of Cocoa Powder dispersed in β-fraction Solution at 9.4% w/w Protein (% w/w)	Gel breaking strength (g)
1.0	510
3.0	505
5.0	770

EXAMPLE 3.

This example shows that when an oil is the dispersed microparticulate, the firmness of the product is independent of the source and physical characteristics of the oil.

Microparticulate dispersions of oils and fats were prepared as in Example 1(b). Aliquots of each oil or fat dispersion were mixed with β-fraction solution so that the final concentration of protein was 9.4% w/w and final oil/fat concentration was 5 % w/w. Portions of each mixture were heated to stabilise the microparticulate dispersion in a gelled protein matrix under conditions as used in Example 1 (a). Gel breaking strength was measured as in Example 1 (a). Results are shown in Table 5.

TABLE 5:

Oil/Fat used at 5% w/w in β-fraction Solution at 9.4% w/w Protein	Gel Breaking Strength (g)
butter oil	570
cocoa butter	515
pork lard	595
sunflower oil	570

EXAMPLE 4.

This example shows that the clarity of gelled product prepared from β-fraction as the gellable protein is modulated by mineral content.

a) *In the absence of dispersed microparticulates*

Aqueous solutions of β-fraction were prepared as in Example 1 (a). At 9.4% w/w protein concentration the concomitant concentration of sodium and calcium chlorides were equivalent to 0.004 and 0.064% w/w respectively. Sodium chloride and calcium chloride were added to aliquots of the β-fraction to achieve concentrations in the range 0.004 to 0.200% w/w sodium chloride and 0.064 to 0.100% w/w calcium chloride. A portion of each β-fraction solution was heated to effect gelation of protein as described in Example 1 (a). Gel breaking strength was measured as in Example 1 (a). Clarity of gels was determined using a Minolta Chromameter on freshly cut slices of gelled product and recorded as L* values, a measure of reflectance. Results are shown in Tables 6 and 7.

TABLE 6:

	Gel Breaking Strength (g)				
Sodium Chloride Concentration % w/w	0.004	0.05	0.1	0.15	0.2
Calcium Chloride Concentration % w/w					
0.064	570	510	540	580	550
0.070	555	nd	545	nd	450
0.080	540	nd	575	nd	440
0.090	545	nd	535	nd	300
0.100	475	nd	355	nd	190

nd = not determined

TABLE 7:

	Reflectance *(L value)		
Sodium Chloride Concentration % w/w	0.004	0.100	0.200
Calcium Chloride Concentration % w/w			
0.064	47.9	61.5	75.2
0.070	49.9	65.2	77.7
0.080	56.5	69.9	76.7
0.090	63.6	74.0	76.4
0.100	64.8	77.3	76.1

* L (water) = 36.5
L (homogenized milk) = 82.3

EXAMPLE 5.

This example shows that microparticulate suspensions may be stabilised in heat-set β-fraction gel sweetened with sucrose.

(a) In the absence of dispersed microparticulates

An aqueous solution of β-fraction was prepared as in Example 1 (a). Aliquots of this solution were mixed with aliquots of sucrose solution so that the final protein concentration was 9.4% w/w and the final sucrose concentration in the range 4 to 12% w/w. Portions of each mixture were heated to effect gelation of the protein as described in Example 1 (a). Gel breaking strength was measured as in Example 1 (a). Results are shown in Table 8.

(b) In the presence of dispersed microparticulates

A microparticulate suspension of cocoa butter was prepared as in Example 1(b). Aliquots of the dispersion were mixed with β-fraction solution

and with sucrose solution so that the final concentration of protein was 9.4% w/w, so that the final concentration of oil was 5.0% w/w and that the final sucrose concentration was in the range 4 to 12% w/w. Portions of each mixture were heated to stabilise the microparticulate suspension in a sweetened gel protein mixture under conditions as used in Example 1(a). Gel breaking strength was measured as in Example 1 (a). Results are shown in Table 9.

TABLE 8:

Sucrose concentration in β-fraction solution containing 9.4% w/w protein (% w/w)	Gel Breaking Strength (g)
4	540
8	560
12	520

TABLE 9:

Sucrose concentration in mixture containing 9.4% w/w β-fraction and 5.0% w/w cocoa butter in dispersion (% w/w)	Gel Breaking Strength (g)
4	500
8	520
12	520

EXAMPLE 6.

This example shows that microparticulate suspensions may be stabilised in heat-set gels of proteins derived from various sources.

(a) Gelation of egg white protein in the absence of dispersed microparticulates

Aqueous solutions of egg white protein were prepared from commercial, spray dried powder at different concentrations of protein and at pH 6.8 as in Example 1 (a). Aliquots of protein solutions were heated to effect gelation as described in Example 1 (a). Gel breaking strength was measured as in Example 1 (a). Results are shown in Table 10.

TABLE 10:

Concentration of egg white protein in solution at pH 6. 8 (%w/w)	Gel Breaking Strength (g)
7.0	85
9.4	195
11.0	290

(b) Gelation of blood plasma protein in the absence of dispersed microparticulates

Aqueous solutions of blood plasma proteins were prepared from commercial, spray dried powder at different concentrations of protein and at pH 6.8 as in Example 1 (a). Aliquots of protein solutions were heated to effect gelation as described in Example 1 (a). Gel breaking strength was measured as in Example 1 (a). Results are shown in Table 11.

TABLE 11:

Concentration of blood plasma proteins in solution at pH 6.8 (%w/w)	Gel Breaking Strength (g)
7.0	235
9.4	510
11.0	690

(c) *In the presence of dispersed microparticulates*

A microparticulate dispersion of butter oil in water was prepared as in Example 1(b). Aliquots of this dispersion were mixed with aqueous solutions of β-fraction, egg white protein (prepared using spray dried egg white powder) or blood plasma protein (prepared from blood plasma protein powder) to achieve final concentrations of protein of 9.4% w/w and final concentrations of oil of 5% w/w. A portion of each mixture was heated to stabilise the microparticulate suspension in a gelled protein matrix under the conditions used in Example 1 (a). Gel breaking strength was measured as in Example 1 (a). Results are presented in Table 12.

TABLE 12:

Source of Gellable Protein in 9.4% w/w protein with various fat contents	Gel Breaking Strength (g)		
Butter oil content % w/w	3	6	9
β-fraction from cheese whey	435	505	460
Egg white	190	210	195
Blood plasma	690	675	700

The following examples show the use of the gelled food products of the invention as "fat replacers" in the preparation of manufactured food items, namely "low-fat" meat products.

EXAMPLE 7

Manufacture of low-fat frankfurter/wiener-type sausage

A frankfurter/wiener-type sausage traditionally contains lean meat and fat in a finely comminuted and uniformly emulsified form with a typical fat content of about 22%. Using a gelled food product in accordance with the invention as fat replacer, as in this Example, the product had a fat content of 6.6 %.

The sausage mix containing the gelled food product was processed using traditional technology and provided a product which was satisfactory with respect to fat distribution, texture and other sensory attributes, but with a much lower fat content than the traditional product.

(a) Preparation of gelled food product as fat replacer

Using the general method set out in Example 1, a gelled food product containing microparticulate pork lard was prepared with a beta-fraction protein content of 8% w/w and a fat content (pork lard) of 12% w/w to provide the required texture and sensory quality in the final product.

(b) Preparation of sausage

Composition

beef (95% c.l.)[1]	6.0 kg
pork (90% c.l.)	4.0 kg
fat replacer[2]	2.0 kg
ice	1.5 kg
sodium chloride	270 g
sodium nitrite	16 g

sodium tripolyphosphate	40 g
seasoning	68 g
ascorbic acid	13 g
garlic	15 g
beef extract	20 g

Notes: 1. c.l. = chemical lean

2. i.e. the gelled food product described in (a) above

Method

The beef and pork were chilled to 4-5 °C and minced separately through a 10mm plate.

Prior to the addition of the fat replacer, it was frozen to -20 °C.

The minced beef, sodium chloride, sodium nitrite and sodium tripolyphosphate were placed in a silent cutter which was run at high speed for five revolutions of the bowl prior to the addition of half of the frozen fat replacer. After an additional 15 revolutions the minced pork plus the remainder of the fat replacer was incorporated together with the ascorbic acid, seasoning, garlic and beef extract. The emulsion was chopped in the cutter until it reached a temperature of 14 °C.

The emulsion was filled into 24mm diameter sheep casings using a vacuum stuffer. The frankfurters were surface dried in a cooker/smokehouse at 50 °C and then smoked at 65 °C for 1.5 hours followed by cooking to an internal temperature of 72 °C. When cooking was complete the frankfurters were showered to cool them and then chilled overnight at 5 °C.

EXAMPLE 8

Manufacture of low-fat Strasburg sausage

A Strasburg sausage traditionally contains coarsely chopped meat and fat distributed in a uniform meat and fat emulsion with a typical total fat content of about 30%. In this Example both chopped and emulsified fat have

been replaced by the gelled food product of the invention to give a product containing 7% fat.

The sausage mix containing gelled food product was processed into Strasburg sausage using traditional technology and resulted in a product with the appearance of a traditional Strasburg sausage and a satisfactory texture and other sensory attributes.

The fat replacer used was prepared as described in Example 7.

Composition

beef (95% c.l.)	2.5 kg
pork (90% c.l.)	2.0 kg
fat replacer	3.25 kg
sodium chloride	155 g
sodium nitrite	1 g
sodium tripolyphosphate	24 g
seasonings	84 g
ascorbic acid	8 g
beef extract	20 g

Method

The beef and pork were chilled to 5 °C and minced separately through a 10mm plate. The fat replacer for the emulsion phase (1.25kg) was frozen to -20 °C. The fat replacer to be used in the non-emulsified form (2.0kg) was chopped from a chilled state at 5 °C.

The beef, sodium chloride, sodium nitrite and sodium tripolyphosphate were chopped in a silent cutter at high speed for 10 revolutions of the bowl. The frozen fat replacer was added and chopped for a further 30 revolutions of the bowl. Seasonings, ascorbic acid and beef extract were added and chopped until the temperature of the emulsion was 10 °C. Coarsely cut (1-5mm) fat

replacer and minced pork were added and mixed into the emulsion in the cutter at low speed for two revolutions of the bowl.

The product was filled into 90mm diameter, moisture impermeable casings and cooked to an internal temperature of 68 °C. After showering to cool the product, it was chilled to 5 °C.

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CLAIMS:

1. A gelled food product characterised in that it comprises a microparticulate suspension of an edible food ingredient in a heat-set gel.

2. A food product as claimed in Claim 1, characterised in that the edible food ingredient is a fat or oil, or a mixture thereof.

3. A food product as claimed in Claim 1 or Claim 2, characterised in that the gel is formed from protein.

4. A food product as claimed in Claim 3, characterised in that the protein is sourced from egg white, blood serum, dairy whey or mixtures thereof.

5. A food product as claimed in Claim 4, characterised in that the protein is enriched beta-lactoglobulin in the form of beta-fraction.

6. A process for the preparation of a microparticulate suspension entrapped in heat-set gels characterised by the steps of:

(a) preparing an aqueous microparticulate suspension or dispersion of at least one edible food ingredient which is insoluble in water or aqueous solutions;

(b) mixing the microparticulate suspension or dispersion from (a) with a protein capable of forming a uniform gel when heated, the proportions of said suspension or dispersion and the protein being suitable to form the desired product;

(c) heat treating the mixture from (b) to form a gel;

(d) cooling the heat-gelled mixture from (c) to ambient or sub-ambient

temperature.

7. A process as claimed in Claim 6, characterised in that the protein added in step (b) is in solid form.

8. A process as claimed in Claim 6, characterised in that the protein added in step (b) is in the form of a solution or dispersion.

9. A process as claimed in any one of Claim 6 to 8, characterised in that the amount of protein added in step (b) is sufficient to provide a gellable protein concentration in the range 10 to 150 g/L of true protein.

10. A process as claimed in any one of Claims 6 to 9, characterised in that the volume of suspended microparticles is not greater than 30% by volume.

11. A process as claimed in any one of Claims 6 to 10, characterised in that the volume of microparticles is less than 15% by volume and the protein content corresponds to from 50 to 110 g/L of true protein.

12. A process as claimed in any one of Claims 6 to 11, characterised in that the protein has a gel breaking strength at least equal to that of gelled egg white with an equivalent protein concentration when heated at 90°C for 30 minutes.

13. A process as claimed in Claim 12, characterised in that the protein is sourced from egg white, blood serum, dairy whey or mixtures thereof.

14. A process as claimed in claim 13, characterised in that the protein is enriched beta-lactoglobulin in the form of beta-fraction.

15. A process as claimed in any one of Claims 6 to 14, characterised in that the heat treatment in step (c) is carried out at a temperature in the range of

25 to 100 °C for from 5 to 120 minutes.

16. A process as claimed in Claim 15, characterised in that the heat treatment is carried out at 60 to 90 °C for 15 to 60 minutes.

17. A food or food material characterised in that it contains a gelled food product as claimed in any one of Claims 1 to 5.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU92/00331

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.[5] A23L 001/0562; A23L 001/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC A23L 001/0562; A23L 001/04; A23L 001/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	Chemical Abstracts, Volume 114, no. 25, issued 1991, June 24 (Columbus Ohio, U.S.A), R.G. Ziegler, "Mircostructure of mixed gelatin-egg white gels: impact on rheology and application to microparticulation". See page 649, column 1, abstract no. 246065n.	1-17
X	Patent Abstracts of Japan, C-265, page 123, JP,A,59-179043 (SANEI KAGAKU KOGYO K.K), 11 October 1984 (11.10.84).	1-17

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 September 1992 (29.09.92)	2 Oct 1992 (02.10.92)

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C(Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
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X	GB,A,1428105 (UNILEVER LIMITED), 17 March 1976 (17.03.76)	1-17
A	AU,A,43394/89 (ENZYTECH INC),5 April 1990 (05.04.90)	1-17
A	AU,B,54411/86 (578879) (SOCIETE DES PRODUITS NESTLE S.A), 25 September 1986 (25.09.86)	1-17
A	AU,B,19347/76 (503174) (UNILEVER LIMITED), 23 August 1979 (23.08.79)	1-17

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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		SE	7612404	US	4103037	ZA	7606635

END OF ANNEX